FRANGIBLE NON-LETHAL PROJECTILE

BACKGROUND OF THE INVENTION

This invention relates generally to the field of non-lethal projectiles or impact munitions and more particularly relates to the field of such projectiles capable of delivering a gas, powder or liquid payload. Even more particularly, the invention relates to such projectiles having a rigid, frangible nose.

It is often desirable to provide for law enforcement, corrections or military users a relatively low-impact, non-lethal projectile for use with firearms or launchers, where the projectile is capable of imparting blunt trauma without deadly force and is also capable of delivering a payload for dispersion upon impact, the payload comprising a gas, liquid or powder having certain desired properties. Such munitions are used for example in crowd control and other special operations, where it is desirable to deter certain activity without utilizing lethal force. The payload may comprise for example marker agents, lacrimators, irritants, inflammatory agents, odorants and the like.

Since the projectile is designed to be direct-fired at the human target, it is necessary to insure that the impact force is sufficient to deliver enough pain to the target for compliance, but without causing serious injury. This is accomplished through the structural design of the projectile as well as by limiting the projectile velocity. Reducing the velocity of the projectile also reduces the accuracy of the trajectory, so a minimum acceptable velocity must be retained. By producing an energy absorbing projectile, sufficient velocity may be maintained for accuracy.

In order to achieve the desired results, projectiles have been developed where the entire projectile or at least the nose of the projectile is formed of a compliant, resilient material that compresses upon impact. The compliant material may take the form of a sphere. Alternatively, the nose of the projectile may be formed of a rubber, sponge or compliant foam material that dissipates impact energy due to compressive elastic deformation. Examples of such projectiles are shown in U.S. Patent No. 3,714, 896 to Young and U.S. Patent No. 6,041,712 to Lyon. A problem can occur with the use of compliant nose materials in that the resilience of the material is detrimental to projectile accuracy due to adverse aerodynamic effects on the non-rigid nose. In addition, the use of compliant or soft materials to retain gas, liquid or powder payloads creates problems in handling and storage, since the projectiles are readily subject to accidental failure, resulting in unwanted dispersal of the payload. Likewise, environmental degradation will more rapidly affect the resilient material containing the payload.

It is also known to produce low-impact, non-lethal projectiles adapted to carry payloads for dispersal on impact where the projectile or the nose of the projectile is made of a frangible material that breaks upon impact as a result of compressive plastic deformation. For example, U.S. Patent No. 6,145,411 to Woddall et al. shows a payload carrying spherical projectile formed of a rigid plastic material and provided with dimples and score lines to create localized stress points that fracture upon impact. The dimples and score lines also create a more accurate spherical projectile through aerodynamic effects. Another example is shown in U.S. Patent No. 5,035,183 to Luxton, where a projectile having the typical bullet-shape is provided, the projectile being composed of a rigid plastic material. Score lines are provided on the projectile such that it will rupture on impact. While the projectile accuracy is more readily maintained in these

designs, the energy dissipation at impact is relatively small and remains concentrated, and the material of construction is more likely to result in injury to the human target since breaking of the projectile results in jagged or sharp edges of relatively non-compliant material. In addition, these projectiles are more likely to deliver serious injury if utilized at short range.

It is an object of this invention to provide a non-lethal, low-impact projectile capable of delivering blunt trauma of sufficient amount to induce compliance as well as to deliver a payload of a gas, liquid or powder substance having desired effects on the human target. It is a further object to provide such a projectile that overcomes the drawbacks inherent in the known systems. These and other objects that will become apparent from the disclosure to follow are accomplished by providing a projectile having a nose formed in an aerodynamically preferred configuration and composed of a frangible, rigid foam material, such that impact energy is dissipated through plastic deformation of the nose, which first compresses and then breaks to disperse the payload. The projectile is capable of being mounted onto known projectile delivery systems for use in known firearms, launchers or the like.

SUMMARY OF THE INVENTION

The invention comprises in general a non-lethal impact munition or projectile adapted to be discharged from a firearm or other launcher device and directed at a human target, wherein the impact energy of the projectile is below the threshold where serious injury or death would result from the impact, yet is of sufficient force such that blunt trauma is delivered for the purpose of pain compliance. The design and structure of the projectile is such that aerodynamic properties and projectile velocity are not excessively adversely affected in order to maintain the accuracy of delivery.

The projectile comprises a projectile nose mounted onto a projectile base, wherein the nose is composed of a frangible, rigid, polymer foam material, such as polyurethane. The nose has a rounded forward end and a cylindrical wall, and the base has a generally flat forward wall and a cylindrical rear wall, adapted to be separably joined to a propulsion shell or casing to form a munition or cartridge capable of being discharged from a firearm or launcher by propulsion means within the propulsion shell, the projectile having a typical bullet shape for aerodynamic purposes. The polymer foam material composing the nose is sufficiently rigid so as to maintain its structural configuration during discharge and flight, but which is crushed and broken upon impact with a human target such that the impact energy is dissipated or reduced. Preferably, the forward end of the nose is thicker than the cylindrical wall of the nose, such that the compression and fracture occurs mainly in the cylindrical wall. The nose may further comprise a rear plug

wall that is directly joined to the forward wall of the projectile base, with the rear plug wall being preferably composed of a resilient, compliant polymer or rubber material.

The projectile nose further comprises a cavity adapted to receive a payload to be dispersed upon impact with the human target. The payload is chosen for a particular purpose and may consist of marker agents, lacrimators, irritants, inflammatory agents, odorants, inert powders or other materials. The crushing and fracture of the projectile nose upon impact laterally expels or disperses the payload, which further reduces the impact energy delivered to the target.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an external view of the invention.

Figure 2 is a cross-sectional view of the invention taken along line II-II of Figure 1.

Figure 3 is a view of the projectile at impact showing dispersal of a payload.

DETAILED DESCRIPTION OF THE INVENTION

With reference to the drawings, the invention will now be described with regard for the best mode and the preferred embodiment, but with the understanding that the scope of the patent is not limited to such and that other variations and embodiments are covered by the language of the claims. In a most general sense, the invention is a projectile, or the projectile in combination with a casing or shell to define an impact munition, to be discharged or propelled from a firearm or similar launcher device such that the projectile is accurately delivered to impact a target, and in particular such that the projectile can strike a human target without inflicting death or serious bodily injury, yet will have sufficient impact force to deliver blunt trauma in an amount designed to inflict sufficient pain so as to cause compliance by the target. In addition, the projectile is designed to be capable of delivering and dispersing upon impact a payload material, such as a liquid, gas or solid, the energy required for payload dispersal acting to further reduce the impact force. To accomplish these purposes, at least a portion of the projectile is designed to crush and fracture upon impact such that some of the impact energy is dissipated.

The structure of the invention must take into account several conflicting and competing requirements for effective operation. The pain inflicted by the projectile at impact must be sufficient enough to force compliance, yet the impact energy delivered to the target must be low enough to prevent serious energy. Projectile accuracy must be maintained through the aerodynamic design of the projectile as well as by maintaining sufficient projectile velocity upon discharge.

Figures 1 and 2 show an external view and a cross-sectional view of the complete impact munition or cartridge of the invention, which is defined to comprise in combination a propulsion casing or shell 10 and a projectile comprising a projectile body 20 and a projectile nose 30. The impact munition is constructed so as to be useable in firearms or launchers of known type, especially those firearms or launchers having rifled barrels, such as for example a 40mm rifled-barrel gas gun or an M203 rifled grenade launcher. The dimensions of the cartridge may vary to accommodate launchers of different caliber (37mm, 66mm, etc.), as well as shotguns of varying gauges. The propulsion shell 10 may be of known type, and is shown to comprise an annular forward wall 14 having a forward shell rim 16 and joined to a shell base 11 having a rear wall 17. A co-axially oriented propulsion cavity 12 is disposed in the shell base 11 and retains propulsion means 13 of known type, preferably a smokeless system. The annular forward wall 14 defines a shell cavity 15 to receive the expanding gases produced by the propulsion means 13 at discharge.

Mounted in separable manner onto the front of the propulsion shell 10 is a projectile comprised of a projectile body 20 joined to a projectile nose 30. The projectile body 20, preferably composed of a polycarbonate material, comprises a forward wall 21 joined to a cylindrical wall 22 such that the combination defines a projectile cavity 23. The exterior of the cylindrical wall 22 is provided with an undercut 24 that defines a rearward extending annular insertion flange 25. The insertion flange 25 is received within the shell rim 16 and shell forward wall 14 in a male-female coupling, such that the projectile cavity 23 and the shell cavity 15 combine to form a single larger cavity.

The projectile nose 30 comprises a rounded forward end 31 combined with a cylindrical wall 32 and is composed of a substantially non-compliant, frangible, rigid, polymer foam material, most preferably a closed-cell polyurethane. The rigidity of the foam must be sufficient for it to retain its structural configuration upon discharge and during flight so as not to adversely affect accuracy, yet be below a rigidity threshold such that the foam is crushed and broken upon impact with soft tissue of a human target in order to dissipate the energy. In other words, the foam must undergo plastic deformation upon impact rather than elastic deformation. It has been found that a polyurethane foam having a density between approximately eight and 14 pounds per cubic foot used to form the forward end 31 and cylindrical wall 32 provides these desired characteristics. The thickness or radial dimension of the cylindrical wall 32 is preferably less than the thickness of the forward end. Through this construction, it is the cylindrical wall 32 that will deform, crush and break upon impact of the projectile with the target 99. The precise shape of the rounded forward end 31 is determined by aerodynamic characteristics well known in the art.

The combination of the forward end 31 and cylindrical wall 32 define a nose cavity 33 that may be empty or that may receive a payload 35 to be dispersed or expelled when the nose 30 is crushed and broken upon impact with the target 99. The payload 35 may comprise a gas, liquid, solid or powder that possesses certain desirable properties when the payload 35 is exposed to the target 99. For example, the payload 35 may comprise alone or in combination a marker agent, a lacrimator, an irritant, an inflammatory agent, an odorant or other material. Likewise, the payload 35 may consist entirely of or include an inert powder. The presence of a payload 35 is preferable since energy is required to laterally disperse the payload 35 upon

impact, and this mass dispersion energy further reduces the momentum energy transferred from the projectile nose 30 to the target 99. This allows the velocity to be increased slightly relative to an empty projectile nose 30 without increasing the kinetic energy transferred to the target 99.

Preferably, the nose 30 further comprises a rear plug wall 34 attached to the rearward end of the cylindrical wall 32 that seals cavity 33. This allows the nose 30 to be manufactured by loading the payload 35 into the cavity 33 and then attaching plug wall 34, by adhesives or other suitable means, prior to attachment to the projectile base 20. Preferably, the rear plug wall 34 is composed of a resilient, compliant polymer or rubber material to further absorb impact energy and to prevent contact of the projectile base 20 with the target 99. The rear plug wall 34 is joined to the face of the base forward wall 21 by adhesives or other suitable means.

At discharge, the projectile base 20 and nose 30 separate from the shell 10 in known manner and travel such that the nose forward end 31 strikes the target 99, as shown in Figure 3. Upon impact the rigid foam forward end 31 is pushed to the rear toward the forward wall 21 of the projectile base 20. The rigid foam cylindrical wall 32 of the nose 30, being of thinner dimension than the forward end 31, crushes and breaks such that openings or tears are created. This absorbs and dissipates energy that would normally be delivered to the target 99. Any payload 35 retained within nose cavity 33 will be expelled laterally in multiple directions.

The use of a closed-cell polyurethane foam or a polymer foam possessing similar characteristics to form the crushable components of the nose 30 has been found to be advantageous for several reasons. The density of the foam is easily controlled during the molding process, which can be performed by reaction injection molding. Specific shapes, contours and cavities are easily produced such that the external aerodynamic contour may be

maximized for best accuracy. The polymer foam material is inert to most payloads and is suitable for retention of gas or liquid as well as a solid or powder. The rigid foam first deforms at impact through compression of air trapped within the cell walls and then breakage of the cell walls themselves, followed by rupture of the foam on a macro scale. The foam nose 30 is sufficiently structurally strong such that it is unlikely to break upon minor impacts that may occur during storage or handling. After deformation and discharge of the payload 35, the crushed forward end 31 and cylindrical wall 32 form in combination with the resilient plug wall 34 a buffer or cushion between the projectile base 20 and the target 99. This distributes the impact energy over the maximum surface area of the projectile, thereby minimizing the chance of penetration by the projectile base 20 into the target 99.

It is understood and contemplated that equivalents and substitutions for certain elements set forth above may be obvious to those skilled in the art, and therefore the true scope and definition of the invention is to be as set forth in the following claims.